Utilization of Oyster Shell to Suppress Estuarine Shoreline Erosion

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Introduction

Gradual estuarine shoreline erosion and accretion occurs throughout South Carolina's marshlands and tidal creeks as the tidelands respond to natural changes within their watersheds. Shorelines of numerous rivers and small creeks have, in some cases, eroded more rapidly than others due to boat generated wave propagation and other anthropogenic disturbances. Sections of Spartina, including entire root systems retaining tidal bottom, have been observed being dislodged during periods of extensive boat activity. Exposed shorelines in the vicinity of heavy boat traffic are the most vulnerable to erosion. The South Carolina Department of Natural Resources (SCDNR) has received a number of complaints from adjacent landowners concerning this continuing problem. Estuarine shoreline areas that have natural oyster populations of oysters (Crassostrea virginica (Gmelin)) and underlying shell matrix, afford protection by buffering or absorbing wave energy before it reaches the adjacent marsh. In addition, an oyster population provides extensive surface area, (estimated to be 50 times the bare intertidal bottom) for habitation by epifauna (Bahr and Lanier 1981). In the marsh-estuarine area that is relatively devoid of hard substrate, oyster shells allow juvenile spat attachment, thus providing the foundation for future generations of shellfish. Alternatively, in areas of significant oyster resources, boat wakes have caused large numbers of oyster shells to accrete as narrow ridges and washover deposits along the exposed shorelines of tidal creeks and rivers. These accumulations of mollusk shells, locally called "washed shell" deposits, are ubiquitous along the Atlantic Intracoastal Waterway (AIWW) (Anderson et al, 1979). Washed shell deposits, remnants of once healthy oyster populations, often have a stabilizing effect on the shoreline and, in many cases, allow for additional accretion.

Materials and Methods

An estuarine shoreline in Hobcaw Creek, a tributary of Charleston Harbor (Figure 1) was cultivated with Crassostrea virginica oyster shells to determine if shell placement in this area would suppress shoreline erosion. One thousand and eighty U.S. bushels of oyster shells were planted using the South Carolina Department of Natural Resources' R/V Oyster CatcherII along 350' of shoreline.

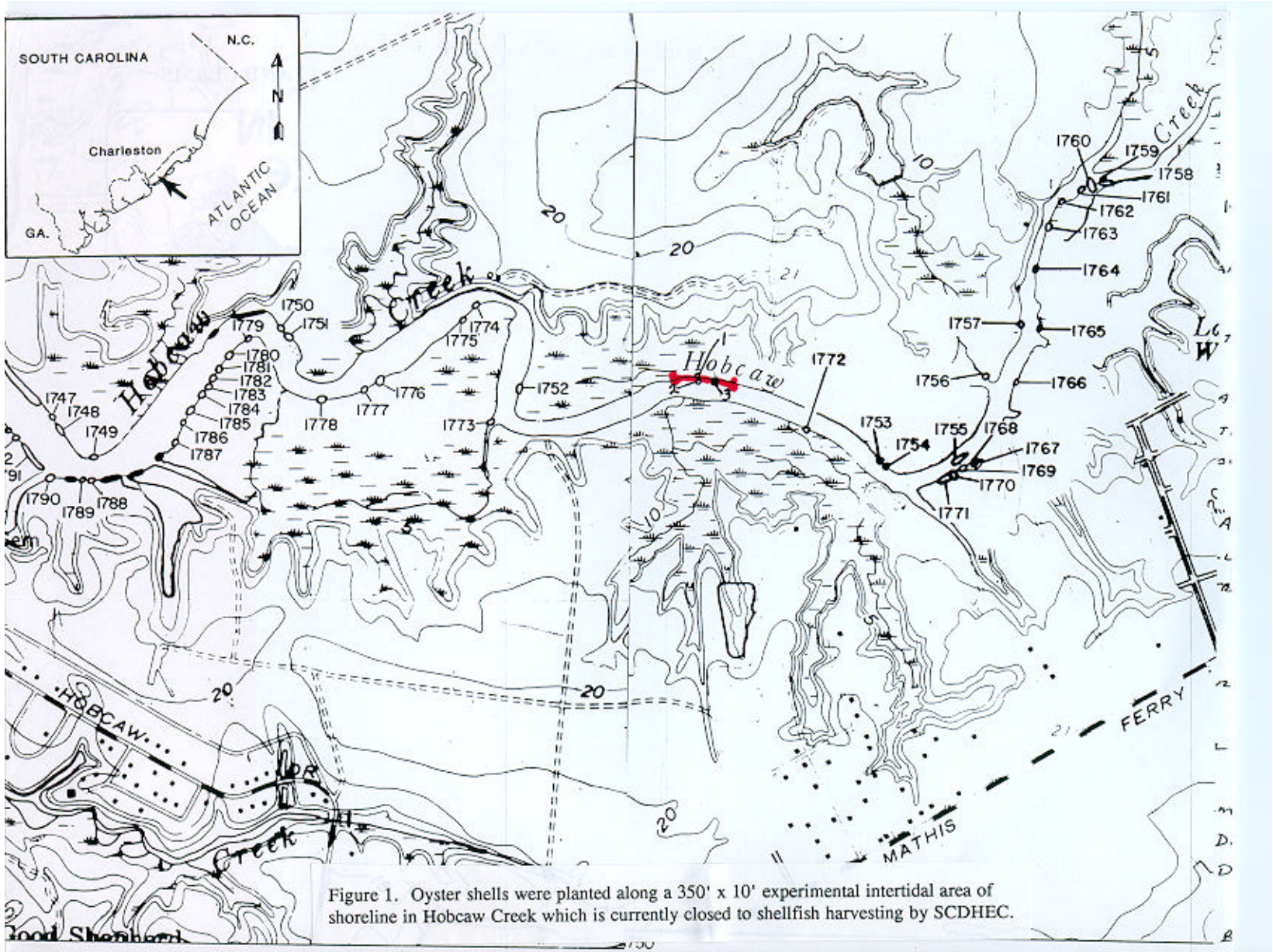

Figure 1. Oyster shells were planted along a 350' x 10' experimental intertidal area of shoreline in Hobcaw Creek which is currently closed to shellfish harvesting by SCDHEC.

The intertidal bottom was covered with oyster shells from MLW to the edge of the Spartina alterniflora marsh, a distance of approximately 10 feet. Following planting, the shoreline was cultivated by hand raking to provide a mean shell thickness of 1.54 inches.

The 350' Hobcaw Creek shoreline was separated into three areas of equal distance: the northeast end was covered with 1 & 1/4 " x 1 & 1/2 " mesh polypropylene netting (Internet). The center section was covered with 6" x 6" degradable steel concrete reinforcing wire in 5' x 20' long sections. This technique has been used previously throughout the State for shellfish cultivation. Treated 2" x 4" T-shaped boards anchored the reinforcing wire with galvanized nails. The southwest area was not covered in order to compare natural shell retention with the other two areas. Both coverings (Internet and reinforcing wire) were secured over the oyster shells to retard erosion and allow for more extensive epibiont fouling.

The project's success will be measured through bimonthly sampling. The stability of the Spartina fringe, located along the edge of the oyster shells will be assessed. An array of six 1 & 1/2" x 10' PVC pipes was established along the perimeter of the experimental area (Figure 2). Measurements will determine the distance (if any) that the Spartina has retreated. Thirty 1 & 1/2" x 36" PVC pipes, with 20 one-centimeter graded increments, have been randomly placed throughout the project. Sampling will indicate the extent of eroded or accreted shells along the experimental shoreline. In addition, an adjacent land owner, Mr. Ken Poole will take photographs and provide visual observations from his dock.

Figure 2. Before and after planting photographs illustrate bottom coverage and placement of one of the six 1 & ½" x 10' PVC pipes established along the perimeter of the experimental area to assess erosion.

Figure 3 illustrates the near absence of oyster populations along the Hobcaw Creek experimental shoreline. Figure 4 shows results of the placement of 1,080 U.S. bushels of oyster shells, although the three experimental zones are not visible in the photograph. Initial analysis indicates that no fouling or oyster spat set has occurred, as would be expected at this time of the year (January 1997). However, the reinforcing wire commenced eroding after less than a month's exposure in estuarine waters. An earlier intertidal oyster resource assessment completed by the SCDNR in 1982 located no oysters along the experimental shoreline. However, the most recent survey (December 1996), conducted prior to cultivating the shoreline found six small populations of intertidal oysters with a total live volume of 17.5 bushels. In addition, a drainage area in the center of the shoreline (covered by reinforcing wire), probably created by dock construction, has washed a number of the recently planted oyster shells away. Figures 5 through 7 show the Hobcaw Creek experimental intertidal area before and after shell planting.

Figures 3 and 4 are panoramic photographs too large to be included in this format showing the Hobcaw Creek experimental intertidal area before and after shell planting.

Figure 5. Hobcaw Creek experimental area before and after shell planting.

Figure 6. Hobcaw Creek experimental area before and after shell planting.

Figure 7. Hobcaw Creek experimental area before and after shell planting.

Discussion

Bi-monthly sampling will indicate the success of using oyster shells for erosion control at these locations through (1) their effect in absorbing wave energy and suppressing erosion in the adjacent marsh behind the planted area, (2) long-term retention of the oysters shells on the intertidal substrate and (3) the capacity of the oyster shells to develop and evolve as a complex three-dimensional intertidal population, i.e. attract oyster spat and fouling organisms and other resident and transient species such as red drum, spotted sea trout, flounder, grass shrimp, penaid shrimp, hermit crabs, blue crabs and many others (Coen et al). If successful, the project provides an ancillary benefit of propagating shellfish restoration.

Many intertidal shellfish habitats throughout the State have been destroyed by shoreline development and boat wake erosion. Based on the permeability and stability of the underlying substrate, this experiment could only be attempted on specific shoreline areas. Approximately three years of observations will be required to fully assess the efficacy of this cultivation technique.

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